

Prostate repositioning using TomoTherapy MVCT imaging capabilities

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Introduction

The on-board MVCT capabilities of a TomoTherapy unit were used to evaluate prostate displacement on patient treated for prostate cancer. Two manual techniques were used to register daily MVCT with the planning KVCT. The techniques are based on visual alignment of bone structures around the prostate and visual alignment of the prostate itself. Comparison of both measured displacement allow to evaluate displacement of the prostate inside the body.

This study should help to design appropriate treatment margins and to find the best way to register prostate patient on TomoTherapy unit.

Material and Methods

35 MV-CT from 5 different patients were used for analysis. Planning KVCT were used as reference images. MVCT were registered using TomoTherapy manual registration option. The images were first aligned using bony structures (pubic symphysis , femoral head) as reference. The prostate (without seminal vesicles) was then used as reference. Due to the low quality of coronal and sagittal images, and due to difficulties to precisely visualize the prostate on these slides, a pre-alignment was done in the lateral and longitudinal direction using bony structure. To be able to compare the two registrations at each point of the images, only translation of the images were allowed (no rotation). The displacement of the prostate inside the body was then evaluated by subtracting the misalignment found with bony structures to the misalignment found with the prostate.

Results

Table 1 gives the displacement (mean \pm standard deviation in mm, n=35) found with both registration methods in each direction, and the absolute value of the displacement of the prostate inside the body.

Registration with bony structures [mm]			Registration with the prostate [mm]			Prostate displacement inside the body (abs. value) [mm]		
Lateral	Longit.	AP	Lateral	Longit.	AP	Lateral	Longit.	AP
3.0 \pm 4.9	-2.8 \pm 5.2	1.8 \pm 4.9	3.2 \pm 4.9	-2.7 \pm 5.2	1.3 \pm 4.1	0.9 \pm 0.8	0.2 \pm 0.5	1.6 \pm 1.5

Table 1

For both registration method, the misalignment vary a lot from day to day and no systematic in the direction was found. Displacement up to 14 mm were found.

The mean displacement of the prostate inside the body is small. The maximal displacement is 6 mm. The largest displacement is in the AP direction and the lowest in the longitudinal direction.

Discussion

With both registration method, we found large misalignments. This is a side effect of MVCT imaging: since position imaging is performed before each treatment, the technicians feel less forced to position the patient properly according to the lasers.

A second conclusion is that, according to our measurements, the prostate does not move significantly into the body between two different treatment fractions. However, the number of patients evaluated in this study is not enough to conclude that bone alignment is sufficient to ensure a good prostate positioning for each treatment.

Finally, our study did not take into account possible rotation for repositioning: this could be of importance during treatment, especially when PTV contains seminal vesicles.